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EXPERIMENTAL STUDIES IN RECALL AND RECOGNITION

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The greater part of experimental work on memory has been on recall. More recently investigators have employed the process of recognition, but few of the differences between the two processes have been reported. The aim of the following experiments was to study the differences between recall and recognition. Tests were made to measure (1) the equivalence of repetitions for recall and recognition, (2) the influence of determination to remember, and (3) the effect of primacy and recency on both recall and recognition.

*The Equivalence of Repetitions for Recall and Recognition.*¹

The difference in the number of repetitions necessary for the mastery of fifteen items was determined for four materials, pictures of objects (lamp, fish, clock, etc.), geometrical forms, words (chair, hammer, car, doll, etc.), and nonsense syllables (fik, vod, deb, ruz, biv, etc.).

Each subject was shown fifteen words successively at regular intervals of two seconds each and then required to write those he remembered. A set of thirty (30) containing the original fifteen (15) was given to the subject from which he was to select fifteen which he thought were in the original set. The first set of fifteen was presented again as before and the subject was requested to recall those he could and then to select fifteen from the thirty set. This was repeated until he was able to recall and recognize the fifteen items correctly. The same experiment was performed for all four materials on twenty-five subjects, all undergraduate or graduate students in Columbia University.

Table I shows the average number of repetitions necessary for complete recall and complete recognition, and the ratio of the two for all materials.

¹ Mulhall. Equivalence of Repetitions for Recall and Recognition, J. of Phil., vol. XI, No. 15, p. 411.

TABLE I

<i>Material</i>	<i>Process</i>	<i>Av. No. Repetitions</i>	<i>M. V.</i>	<i>Ratio Av. for Recall to Av. for Recog.</i>
Pictures.....	{ Recall.....	3.36	.79	3.23
	{ Recog.....	1.04	.08	
Forms.....	{ Recall.....	3.96	.85	2.2
	{ Recog.....	1.80	.81	
Words.....	{ Recall.....	4.76	1.61	1.80
	{ Recog.....	2.64	.96	
Syllables.....	{ Recall.....	7.12	2.23	1.22
	{ Recog.....	5.80	2.11	

The data indicate that the difference between recall and recognition memory is greatest for pictures, somewhat less for forms and words, and least for nonsense syllables. The number of repetitions required for both recall and recognition is least for pictures, greater for forms and words, and greatest for syllables. In examining the materials one finds that the pictures offer the greatest richness of associations. The forms offer somewhat fewer advantages—the shape can be visualized, in a few cases they can be named, and associations, but few in number, can be made. The third material, words, all being nouns, are names and have associations, but lack any particular picture or form element. The syllables, as their name implies, are nonsense; most, if not all, are devoid of any association. Introspections of the subjects indicate that association was employed as an aid in memorizing.

The following secondary experiment shows this more definitely. To each of two subjects a mixed set of sixteen items (four pictures, four forms, four words, four syllables) was presented, one unit every two seconds. Careful introspections were called for as each item was afterwards recalled. The subjects were also required to select sixteen from a set of thirty-two (eight of each material). A few of the records are given as examples of the means the subjects used to aid memory.

<i>Pictures remembered</i>	<i>Why and How</i>
butterfly.....	Benefit Performance of Madam Butterfly to be given for the College.
car.....	Its many uses, with engine, auto, etc.
coat.....	Livery.
bridge.....	A particular bridge in Sullivan County.
lamp.....	Toaster received yesterday which I connected to a lamp.
nuts.....	Walnuts I bought today.
<i>Words</i>	
tree.....	Curious tree examined on a recent walk.
knife.....	Bread.
<i>Syllables</i>	
naf.....	Nap.
jod.....	Jodl, psychologist.

Forms: The forms reminded the observers of "a diamond," "a windmill," "exclamation point," "color disc," "pie," and "kindergarten shapes."

The introspections of both subjects show clearly the method of association in recalling the material and the difficulty and often inability of remembering material with few or no associations.

Since the greatest difference in recall and recognition memory is for pictures when the material has an abundance of association, less for forms and words, and least for syllables where associations are respectively less, it appears that the difference in recall and recognition memory is in part dependent on the richness of associations present.

The Influence of Determination to Remember on Recall and Recognition

The influence of determination to remember on recall and recognition was determined for two materials, one rich with associations, the other devoid of them. Twenty (20) photographs (15 men, 5 women) with names attached, and fifteen (15) nonsense syllables were used. Fifty subjects were tested, twenty-five with no determination to remember and twenty-five with determination to remember the material. The first

group was asked to take part in an experiment in judgment. Each subject read the following instructions:

"Arrange the 15 nonsense syllables in four piles according to ease of articulation. You will be given two minutes to do this."

and was given a set of fifteen (15) cards on each of which was typewritten one syllable, and four cards labeling the four piles, "Very Easy," "Fairly Easy," "Slightly Easy," "Indifferent." If the arrangement was made before the two minutes had expired the subject was urged to make sure the arrangement was satisfactory. At the end of the two minutes the observer was asked to make a record of the syllables in each pile on the blank provided.

Twenty photographs with names attached and four cards labeling the piles "Very Attractive," "Fairly Attractive," "Slightly Attractive," "Indifferent," were given to each observer with the following instructions:

"Arrange the 20 pictures in four piles as indicated. You will be given 2 minutes to do this."

After the two minutes had expired each subject was requested to record the names of the pictures in each pile on the blank provided. This was done to make sure the subject looked at the names under the pictures.

The subject's memory for both materials was tested. Three minutes were given for the recall of the syllables and then a selection of fifteen from a set of thirty, fifteen of which were in the original set, was made. The observer was asked to recall the names of photographs in three minutes. A set of forty photographs, twenty being those of the original set without names, was provided with the following directions:

"Select 20 pictures from this group which you think were previously shown. Name any which you can."

After the subject had selected the photographs, a set of forty cards on each of which was typewritten a name (twenty were the names attached to the photographs in the original set, twenty were other names) was used for the recognition of names. Care was taken not to repeat any name, either first or last, nor to use the last name of any well-known person.

The second group of twenty-five subjects first copied the list of syllables and names on the pictures. This was done in order to control the conditions, keeping them, as far as possible, identical with those of the first group. If such a record

had not been required for the group which was judging, one could not be sure that the subjects read the names. Even with this precaution, the subjects claimed they had never looked at them, until reminded they had written each on the blank.

After making these copies, the subjects of the second group were given the set of fifteen nonsense syllables with these instructions:

"You will be given 2 minutes to look at these 15 syllables. Later you will be called upon to remember them, so look at each with a *determination to remember it*."

After the two minutes had expired, the set of photographs was presented with the directions:

"You will be given 2 minutes to look at these 20 pictures. You will afterwards be called upon to remember the names and photographs, so look at each with a *determination to remember*."

Recall and recognition were tested in the same way as for the first group.

Throughout the experiment an attempt was made to keep the conditions for both groups the same. Any sources of error or awkwardness in conducting the experiment, due to the difficulty of keeping the observers of the first group ignorant of the purpose of the investigation, which may give rise to criticism, will be found to be constant for both groups.

The purpose of the experiment was (1) to compare recall memory, with and without determination to remember, with recognition, with and without determination to remember, respectively; (2) to compare recall and recognition with determination and recall and recognition with no factor of determination present; and (3) (a) to compare recall of syllables, with and without the intention to remember, with recall of names with and without determination, and (b) to compare recognition of syllables with and without the intention to remember with recognition of photographs and names with and without the intention to remember.

In Table II the total number recalled and recognized by both groups is given for both materials. Table III shows the ratio of recall with a determining factor present to recall with no such factor present and the ratio of recognition with a determining factor to recognition without the determining tendency for both materials. Table IV gives the ratio of recog-

niton with determination to recall with determination and the ratio of recognition without determination to recall without determination for both materials.

TABLE II

	SYLLABLES No Determination		Determination	
	<i>Recall</i>	<i>Recog.</i>	<i>Recall</i>	<i>Recog.</i>
Total.....	126	318	155	326
Average.....	5.0	12.7	6.20	13.0
M. V.....	1.65	1.26	2.06	.73

PHOTOGRAPHS AND NAMES

	No Determination			Determination		
	<i>Recall</i>	<i>Recog.</i> N.	<i>Recog.</i> Ph.	<i>Recall</i>	<i>Recog.</i> N.	<i>Recog.</i> Ph.
Total.....	77	391	461	134.5	435	415
Average.....	3.08	15.6	18.4	5.36	17.4	16.6
M. V.....	.90	1.53	1.48	1.57	1.44	1.90

TABLE III

SYLLABLES

Ratio of Determined Recall to Undetermined Recall.....	100 : 81.3
Ratio of Determined Recog. to Undetermined Recog.....	100 : 97.5

PHOTOGRAPHS AND NAMES

Ratio of Determined Recall to Undetermined Recall.....	100 : 57.2
Ratio of Determined Recog. to Undetermined Recog.....	100 : 99.7

TABLE IV

SYLLABLES

Ratio of Determined Recog. to Determined Recall.....	100 : 47.55
Ratio of Undetermined Recog. to Undetermined Recall.....	100 : 39.62

PHOTOGRAPHS AND NAMES

Ratio of Determined Recog. to Determined Recall.....	100 : 15.82
Ratio of Undetermined Recog. to Undetermined Recall.....	100 : 9.03

TABLE V

Ratio of Det. Rc. of SYLLABLES to Det. Rc. of NAMES.....	100 : 86.8
Ratio of Undet. Rc. of SYLLABLES to Undet. Rc. of NAMES..	100 : 61.1
Ratio of Det. Rg. of SYLLABLES to Det. Rg. of NAMES and PHOTOGRAPHS.....	100 : 260.6
Ratio of Undet. Rg. of SYLLABLES to Undet. Rg. of NAMES and PHOTOGRAPHS.....	100 : 267.9

In Table V the materials are compared. The ratios of recall of syllables to recall of names are presented with no determination and with determination to remember; the ratios of recognition of syllables to recognition of photographs and names with and without determination to remember are also stated.

It will be noticed that fewer photographs were recognized when there was a determination to remember present, but many more names. This does not mean that determination to remember decreases one's ability to recognize faces. The larger number of names recognized with determination to remember seems to indicate that the observers considered names more difficult to remember and spent most of the time allotted to them to learn names. The total number of photographs and names recognized with determination to remember was 850 and without 852, or an average in each case of 34 items. Throughout, the calculations involving the recognition of the material with greater meaning the totals 850 and 852 have been used. Frequently a subject could recall the first or last name but not both; in each case the score of one-half was given (Table II).

TABLE VI
RECALL OF NAMES

	No Determination			Determination		
	1st only	2nd only	Both	1st only	2nd only	Both
Total.....	40	50	32	49	62	79
Total First Names.....		72			128	
Total Last Names.....		82			141	

The data indicate the following: (1) the factor of determination to remember influences recall memory, but its effect on recognition is little, if any; (2) the difference between recall and recognition is less when there is a determination to remember the material than when there is no intention to remember; (3) the influence of determination for the recall of names is greater than for the recall of nonsense syllables; there is little, if any effect of determination to remember on the total number of items recognized of either material.

A further study of the data for the recall of names shows interesting results. When no determining factor was present 72 first names were recalled and with determination 128, or an increase of 77 per cent; with no determination to remember 82 last names were recalled, with intention present 141, or an

increase of 72 per cent; with no determination total number recalled 77 and with determination 134.5, or an increase of 75 per cent. Determination to remember seems to influence the recall of first and last names to the same degree. Determination to remember influences greatly the number of first and last names correctly connected, as there were only 32 with no determining factor and 79 with one, or an increase of 147 per cent. Moreover, the determining tendency influences the number of photographs which may be correctly named. Table

TABLE VII
NAMES CORRECTLY ASSOCIATED WITH PHOTOGRAPHS

	No Determination				Determination			
	1st	2nd	Both	Total	1st	2nd	Both	Total
Total.....	2	9	13	18.5	10	24	48	65.0
Highest Score...	1	3	4	4	3	4	7	8
Lowest Score....	0	0	0	0	0	0	0	0

VII shows the number of first, last, and whole names which were correctly assigned to the photographs for both groups of subjects. According to the method of scoring adopted, 18.5 names were correctly given to the photographs by the first group and 65 by the second.

The Effect of Primacy and Recency

The third part of the investigation was concerned with determining the influence of primacy and recency on recall and recognition. Thirty-eight subjects were tested for two materials, nonsense syllables and photographs. To nineteen, a list of twenty-four nonsense syllables was presented at the rate of one item every two seconds in a given order 1 through 24. Immediately after the presentation they were asked to recall all they could in three minutes and then were given a list of forty-eight from which to select 24 which they thought had been previously presented. The subjects were then shown twenty-four pictures at the rate of one every two seconds. As each was presented a name was pronounced by the experimenter. Immediately after the presentation, they were given three minutes in which to recall the names. A set of forty-eight photographs, containing the original twenty-four, was used for the recognition test. Each subject was then provided with a list of forty-eight names from which to select twenty-four which he thought had been pronounced as the pictures were presented. The experiment was repeated on

the second group of nineteen, but the photographs were shown first and the syllables second, and the order of each material was 13 through 24, 1 through 12.

The results were calculated according to the position of the item, *i. e.*, for position 1 the record is given for the number of times item 1 was remembered by members of the first group, and item 13 by members of the second group; position 2, the number of times item 2 was remembered by the first group, and item 14 by the second group; and so on until position 24 shows the number of times item 24 and item 12 were remembered by the first and second groups respectively. (Table VIII.)

TABLE VIII (see Charts)

PRIMACY AND RECENCY

Position	Syllables		Photographs and Names		
	<i>Recall</i>	<i>Recog.</i>	<i>Recall N.</i>	<i>Recog. N.</i>	<i>Recog. Ph.</i>
1	23	36	3.5	31	27
2	16	34	0	14	19
3	19	34	5	34	28
4	14	27	3	29	17
5	9	32	3.5	29	20
6	10	19	4	29	22
7	6	30	2.5	30	20
8	2	28	4.5	24	32
9	10	29	2.5	24	20
10	8	26	3.5	21	16
11	8	28	4.5	24	27
12	6	27	2.0	24	17
13	11	30	7.5	26	28
14	11	26	.5	19	15
15	9	19	9.0	31	26
16	10	23	4	23	12
17	6	28	4	22	25
18	5	20	3.5	22	25
19	10	27	2	21	24
20	10	20	6.5	29	29
21	6	22	5	20	15
22	19	32	11	24	18
23	11	22	20	35	32
24	21	31	30.5	33	13
Average	10	27	5.9	25.7	21.9

Since one is able to recognize much more than one can recall, any factor which increases recall memory by one unit may not have the same influence on recognition memory when it, too, is increased by one item. The relation of the total number recalled for each position to the average number recalled of all the positions is used as a measure of the effect of position for recall and the relation of the total number

recognized for each position to the average number recognized is used as the measure of the effect of position for recognition. The accompanying charts show the influence of primacy and recency for both processes and for both materials.

Primacy and recency influence both recall and recognition of nonsense syllables, both are more effective in the former than in the latter case. As far as the data of this experiment indicate, the influence of primacy and recency is about the same. Turning to the chart for names and photographs, one notices no effect of either primacy or recency for recognition. Primacy has only a slight effect, if any, for recall, but recency shows a marked influence on recall.

The results will allow only suggestive conclusions, but it

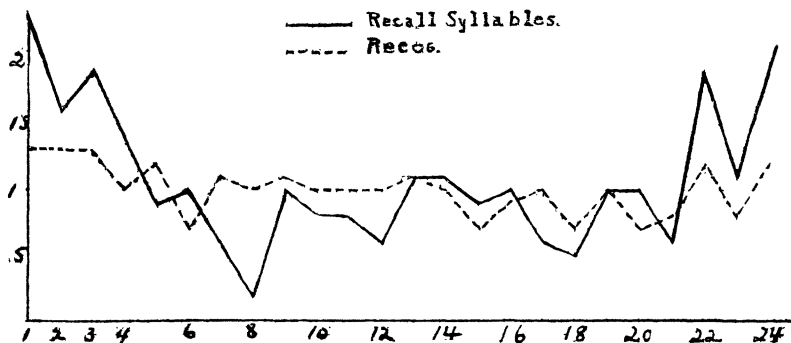


CHART I

Horizontal Scale: Position of the item. Vertical Scale: Ratio of the number remembered for each position to the average.

appears that primacy and recency influence recall memory more than recognition. The influence of both on recognition is greater the less meaning the material has.

The results of experimental studies in memory may lead to practical applications. We have long known that the value of a single presentation is greater in recognition than in recall, and we may add that the difference in the value of repetitions is greater for material with meaning and less for material without meaning. Advertisers will find it takes fewer presentations for prospective customers to recall and recognize a trade-mark which has a wealth of associations.

Banks are eager for competent detectives who will recognize and often associate the correct name to each man and woman who is a depositor. The individual differences shown in

Table VII indicate that people vary in their ability to identify and name faces. A test similar to this might serve as a means of selecting competent bank detectives.

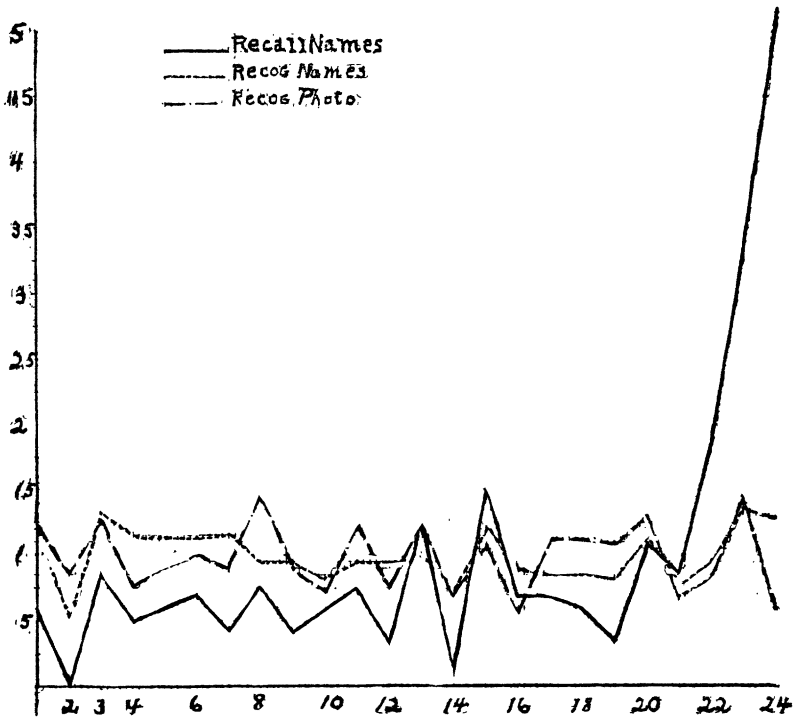


CHART II

Summary

In general, the difference between recall and recognition varies with the materials remembered and with the same material when different influences are present.

1. The difference between recall and recognition is greatest when the material is rich with associations and becomes less the fewer the associations in the material.

2. Determined recall differs from undetermined recall more than determined recognition differs from undetermined recognition.

3. The difference between determined recall and determined recognition is less than that between undetermined recall and undetermined recognition.

4. The influence of a determining factor is greater for recall of material rich with associations than for material devoid of them.

5. The determining factor influences the amount of material remembered which can be correctly associated with other material remembered.

6. Primacy and recency both influence recall memory. The influence of each on recognition is less than on recall, but is greater for material devoid of associations and less for material rich with associations.